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## II. *An Account of an Experiment, touching the Quantity of Air produced from a certain Quantity of Gunpowder Fired in common Air; by Mr. F. Hauksbee, F.R.S.*

**I** Took a fine Glas Tube about 36 Inches long, the Diameter of its Bore about three quarters of an Inch: Its upper Orifice had a Brass Ferrel solder'd to a Screw cemented on it, to which was screw'd a Cock. The lower or bottom part was naked and open (without the Bladder made use of when I made the Experiment before the Society, for I since found that to be needless): near the upper part of this Tube within, was fixt a piece of Cork, notch'd on its Edges, to give the greater liberty for the Explosion to vent it self. The Cork had a small Cavity in its middle, the better to receive and hold the *Gunpowder*, which was let down on it, through a small Glas Funnel, before the Cock was screw'd on. In this manner the lower Orifice was plung'd under the Surface of a Vessel of Water; the Cock being then screw'd on and open, it was easie, by sucking at it with ones Mouth, to remove the inward Air, whereby the Pressure of the outward Air would raise the Water in it to any determinate height. The Tube before being measured by an accurate Cubical Inch, and graduated by a File on its outside. When the Water had ascended to the design'd Mark by the prementioned Means, the Cock was turn'd, which suspended it there: Then the Focus of a burning Glas being cast on the Powder, it soon fir'd, blowing the Wa-

ter down violently, but suddenly rising again, rested so much below the Mark it stood at before firing, as was equal to the Quantity of seeming Air produced from it. The quantity of *Gunpowder*, used in this Experiment, was one exact Grain Weight; and I found the quantity of space the Water had deserted, just after the Explosion, was equal to the bulk (nearly) of a Cubical Inch of *Gunpowder*, whose Weight was 222 Grains: So that 222 Grains Weight of the same Powder, as soon as fir'd, seems to produce something to possess the space of so many Cubical Inches of Air. Now whether the space deserted by the Water is possess'd by a Body of the same Weight and Density, or is of the same quality of common Air, I dare not determine; Since an Experiment I have lately made, to try how much the heat produced by the Explosion of the *Gunpowder*, might contribute to the largeness of the space dispossest'd by the Water, seems to conclude it otherwise. For I found that when the *Gunpowder* had been fir'd an Hour, the Water had ascended about  $\frac{2}{5}$  of the whole deserted space, which was in length about  $2\frac{1}{4}$  Inches, and was equal to about a Cube Inch in quantity: The space in length was divided into 20 equal parts; at two Hours after firing, it had ascended near  $\frac{3}{4}$  of the same. By that time I judg'd it might become of an equal degree of Temperature with the outward Air: But still continuing the Experiment, I found (to my great surprize) that two Hours after the last Observation, the Water had reach'd to about  $\frac{7}{8}$ . Next Morning, which was at about 18 Hours distance, I took notice it had arrived to near  $\frac{1}{2}$ , or half of the first deserted space. Thus continuing rising, I found that at the end of 12 Days, the Water had ascended something above  $\frac{1}{2}$  of the same. At 18 Days it had arrived to 19 of the 20 parts at first deserted; and at that Station it continued without alteration for 8 Days: So that the seeming real Air, produced

duced from the fir'd Grain weight of *Gunpowder*, was equal but to the bulk of 11 Grains of the same; that Number being nearly the 20th part of 222, the Number of Grains contain'd in a Cubical Inch, as aforesaid. Which shews that the whole space at first deserted by the Water upon firing the *Gunpowder*, was not supply'd with real Air. The Temperature of the Air I all along considered, and found it contributed nothing to this odd Phænomenon, which how to account for I know not; I only suggest, that the Springs, or Constituent parts of the Ambient Air, as well as those contain'd in the Body of the *Gunpowder*, may, upon firing, be capable of being broken, or at least so Distended, as to possess so large a space, and require so long a time to recover their Natural State again. And this, I presume, could never have been discover'd but by the confinement of the same Air in which the Explosion was made.

And as this Discovery is altogether new, so the Application of it may be as useful. But I shall wholly leave that to this Honourable Society, who best know how, most aptly to apply it.

Notwithstanding the Account of this Experiment seems to Run-counter with the Accounts formerly given of the firing of *Gunpowder* in *Vacuo*; yet considering the different Mediums in which the Experiments were made, they may be the easier reconcilable: For when the *Gunpowder* was fired in so thin a Medium as the near approach to a *Vacuum*, that then the remaining Air in the Receiver could suffer by the Explosion, but in proportion to the Quantity, which must be so inconsiderable, as not to be taken notice of. Besides, when I come to repeat those Experiments, I doubt not but I shall discover some Occurrences that were then past by unheeded, that may render them more agreeable to this last, than they now seem to appear.